resource-based industries whose operations would result in substantial increases in revenue to state and local government.

5.44 Summary: Study Area Economics

Implementation of the CR 550 route will not provide efficient and direct access to natural resources within the western portion of the study area. Development of natural resources will be less advantageous due to increased cost of haulage and fleet maintenance engendered by the longer length of this route as compared to CR 595, as well as the societal costs presented in this evaluation.

The CR 510-Red Road-Sleepy Hollow route likewise does not provide efficient access to natural resources within the western portion of the study area. The cost of haulage, fleet maintenance, and many other costs associated with this route would be substantially higher than the proposed CR 595.

The proposed CR 595 route provides the shortest and most direct route between industry production sites (i.e. mining and timber) and the associated ore processing facilities and timber market destinations. CR 595 would foster economic growth by providing the greatest transportation efficiencies for resource-based businesses.

The proposed CR 595 route will support resource-based industry production of timber and metals and also will support increased tourism and recreation opportunities. These activities form the foundation of the economy of Marquette County, and directly contribute to its tax base. The efficiencies of the shorter transportation route that would be provided by CR 595 would substantially enhance the viability of these businesses and tourism/recreation. Implementation of the proposed CR 595 project is the most direct north-south route to meet the purpose and need for the transportation/vehicular infrastructure of Marquette County.

5.45 Affected Environment: Air Quality

The air quality in Marquette County is currently in attainment for all of the National Ambient Air Quality Standards (NAAQS) for which federal air quality criteria have been issued. These include Ozone, Particulate Matter, Lead, Sulfur Dioxide, Nitrogen Oxides and Carbon Monoxide.

The Air Quality Division (AQD) of the MDEQ operates a network of air monitors to measure the levels of various pollutants in the ambient air. Presently, there is one air quality monitor in the Upper Peninsula located in the town of Seney in Schoolcraft County. This monitor only measures ozone. In 2009, the monitor operated for 184 days which is the length of the ozone season. Air quality was assessed as good for 178 days, moderate for 5 days and 1 day was assessed as unhealthy for individuals with health conditions that would be negatively impacted by elevated ozone levels. Overall recorded levels of ozone were considered safe for the general population.

Three routes in the study area were evaluated for potential generation of criteria pollutants as well as potential contribution of greenhouse gases using available emission factors. Information on the criteria pollutants that were evaluated is presented below. These data were obtained from the 2009 State of Michigan Air Quality Report. A summary of characteristics for each criteria pollutant including potential sources and populations that may be at risk for exposure have been provided.

5.45.A. Carbon Monoxide (CO)

Carbon monoxide is a colorless, odorless and poisonous gas formed during incomplete burning of fuel. Levels peak during colder months primarily due to cold temperatures that affect combustion efficiencies of engines. Outdoor exposure sources are automobile exhaust, industrial processes (metal processing and chemical production), non-vehicle fuel combustion, and natural sources such as forest fires.

Individuals who suffer from cardiovascular (heart and respiratory) disease are most at risk for exposure to elevated levels of CO. People with angina and peripheral vascular disease are especially at risk as their circulatory systems are already compromised and less efficient at carrying oxygen. However, elevated CO levels can also affect healthy people.

5.45.B Sulfur Dioxide (SO_2)

Sulfur dioxide is a colorless gas formed by the burning of sulfur-containing material. Odorless at typical ambient concentrations, SO_2 can react with other atmospheric chemicals to form sulfuric acid. When sulfur-bearing fuel is burned, the sulfur is oxidized to form SO_2, which then reacts with other pollutants to form aerosols. In liquid form, it is found in clouds, fog, rain, aerosol particles, and in surface films on these particles. Coal-burning power plants are the largest source of SO_2 emissions. SO_2 is also emitted from smelters, petroleum refineries, pulp and paper mills, transportation sources, and steel mills. Other sources include residential, commercial and industrial space heating.

Asthmatics, children, and the elderly are especially sensitive to SO_2 exposure. Asthmatics receiving short-term exposures during moderate exertion may experience reduced lung function and symptoms, such as wheezing, chest tightness, or shortness of breath. Depending on the concentration, SO_2 may also cause symptoms in people who do not have asthma.

5.45.C Nitrogen Dioxide (NO_2) and Oxides of Nitrogen (NO_x)

Nitrogen dioxide is a reddish-brown, highly reactive gas formed through oxidation of nitric oxide (NO). Upon dilution it becomes yellow or invisible. High concentrations produce a pungent odor and lower levels have an odor similar to bleach. NO_X is the term used to describe the sum of NO, NO_2, and other nitrogen oxides. NO_X can lead to the formation of O_3 and NO_2, and can react with other substances in the atmosphere to form acidic products that are deposited in rain (acid rain), fog, snow, or as particulate matter.

NO_X compounds and their transformation products occur both naturally and as a result of human activities. Natural sources of NO_X are lightning, certain biological processes, including a biological process in soil, and stratospheric intrusion. Ammonia and other nitrogen compounds produced naturally are important in the cycling of nitrogen through the ecosystem. The major sources of man-made (anthropogenic) NO_X emissions, which account for a large majority of all nitrogen inputs to the environment, come from high temperature combustion processes such as those occurring in automobiles and power plants. Home heaters and gas stoves produce substantial amounts of NO_2 in indoor settings.

Individuals with pre-existing respiratory illnesses and asthmatics are more sensitive to the effects of NO_2 than the general population. NO_2 exposure can also increase respiratory illnesses in children.

5.45.D. Ozone (O_3)

Ground-level O_3 is created by photochemical reactions involving nitrogen oxides (NO_X) and volatile organic compounds (VOCs), or hydrocarbons, in the presence of sunlight. These reactions usually occur during the hot summer months as ultraviolet radiation from the sun initiates a sequence of photochemical reactions. O_3 is also a key ingredient of urban smog. In the Earth's lower atmosphere, also known as the troposphere, ozone is an air pollutant. Ground level ozone can also be transported hundreds of miles under favorable meteorological conditions. Ozone levels are often higher in rural areas than in cities due to transport to regions downwind from the actual emissions of ozone forming air pollutants. Shoreline monitors along Lake Michigan often measure high ozone concentrations due to transport from upwind states.

Major sources of NO_X and VOCs are engine exhaust, emissions from industrial facilities, combustion from power plants, gasoline vapors, chemical solvents, and biogenic emissions from natural sources. Ground-level O_3 can also be transported hundreds of miles under favorable meteorological conditions. As a result the long-range transport of air pollutants impacts the air quality of regions downwind from the actual area of formation.

Individuals most susceptible to the effects of O_3 exposure include those with a pre-existing or chronic respiratory disease, children who are active outdoors and adults who actively exercise or work outdoors.

5.45.E. Particulate Matter (PM_{10}, $PM_{2.5}$)

Particulate matter is a general term used for a mixture of solid particles and liquid droplets found in the air, which is further categorized according to size. Large particles with diameters of less than 50 micrometers (μm) are classified as total suspended particulates (TSP). PM_{10} are "coarse particles" less than 10 μm in diameter (about one-seventh the diameter of a human hair) and $PM_{2.5}$ are much smaller "fine particles" equal to or less than 2.5 μm in diameter.

Particulate matter can be emitted directly (primary) or may form in the atmosphere (secondary). Most man-made particulate emissions are classified as TSP. PM_{10} consists of primary particles that can originate from power plants, various manufacturing processes, wood stoves and fireplaces, agriculture and forestry practices, fugitive dust sources (road dust and windblown soil), and forest fires. $PM_{2.5}$ can come directly from primary particle emissions or through secondary reactions that include VOCs, SO_2, and NO_X emissions originating from power plants, motor vehicles (especially diesel trucks and buses), industrial facilities, and other types of combustion sources.

$PM_{2.5}$ has been linked to serious health effects. People with heart or lung disease, the elderly, and children are at highest risk from exposure to particulate matter.

5.45.F. Greenhouse Gas

U.S. Environmental Protection Agency's (EPA) "Proposed Endangerment and Cause or Contribute Findings for Greenhouse Gases" Under Section 202(a) of the Clean Air Act, published at 74 FR 18886 (April 24, 2009) listed two specific findings; 1) the current and projected concentrations of the six key well-mixed greenhouse gases — carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6) — in the atmosphere threaten the public health and welfare of current and future generations and, 2) the combined emissions of these well-mixed greenhouse gases from new motor vehicles and new motor vehicle engines contribute to the greenhouse gas pollution which threatens public health and welfare. These findings were signed by the EPA Administrator on December 7, 2009. On December 15, 2009, the final findings were published in the Federal Register under Docket ID No. EPA-HQ-OAR-2009-0171.

The findings do not impose any requirements on industry or other entities. However, this action is a prerequisite to finalizing the EPA's proposed greenhouse gas emission standards for light-duty vehicles, which EPA proposed in a joint proposal including the Department of Transportation's proposed Corporate Average Fuel Economy (CAFÉ) standards on September 15, 2009.

5.46 Environmental Consequences: Air Quality

The potential for pollutant emissions from vehicle use for each of the three routes in the project study area was evaluated. Various emission factors were evaluated to assess on-road mobile source emissions for various criteria pollutants and greenhouse gases by assorted vehicle types. The emission factors for particulate matter (PM), carbon monoxide (CO), sulfur dioxide (SO_2) and the greenhouse gases take into account vehicle miles traveled per route over a specified time period. For ozone, which uses an emission factor for volatile organic compounds (VOCs) which are precursors to ozone and oxides of nitrogen, the emission factors also take speed of the vehicle into account.

One model generated the emission factors to address the operation of both light duty vehicles (< 8,500 pounds) and heavy vehicles (> 8,500 pounds) like delivery trucks and logging trucks and also "heavy heavy duty diesel vehicles" (> 33,000 pounds) used for construction or heavy transportation. A second model broke down vehicle classifications to two groups, light vehicles and all vehicles. Emission factors selected for the comparison of the routes evaluated were based on recommendations from the MDOT and MDEQ AQD staff. The VOC and NO_X emission factors are from MDOT and the other pollutant emission factors are from the EMFAC 2007 (v2.3) BURDEN model developed by California's South Coast Air Quality Management District. Both sets of emission factors are derived from the following equations:

VOC and NO_X Emissions (pounds per day) for Light Duty Vehicles = N x TL x EF1 based on speed of vehicle

VOC and NO_X Emissions (pounds per day) for All Vehicles = N x TL x EF1 based on speed of vehicle

CO, PM_{10}, $PM_{2.5}$, SO_2, CO_2 and CH_4 Emissions (pounds per day) for Light Duty Vehicles = N x TL x EF2

CO, PM_{10}, $PM_{2.5}$, SO_2, CO_2 and CH_4 Emissions (pounds per day) for Heavy Duty Vehicles = N x TL x EF2

CO, PM_{10}, $PM_{2.5}$, SO_2, CO_2 and CH_4 Emissions (pounds per day) for Heavy Heavy Duty Vehicles = N x TL x EF2

Where N = number of trips per vehicle type, TL = trip length (miles per day), EF1 = emission factor (pounds per mile) at rated mile per hour and EF2 = emission factor (pounds per mile).

Transportation parameters and assumptions used to model emissions for the three routes evaluated are shown in Table 5-10 and 5-11 below. The number of vehicle trips per route and vehicle type was kept constant for all routes.

Table 5-10. Air Quality Emission Modeling Transportation Parameters.

Route	Route ID	Length of Route[1] (Miles)
CR 550	550	60.0
CR 510-Red Road-Sleepy Hollow	Red/SH	42.0
CR 595	595	22.5

[1]Source: Coleman Engineering

Table 5-11. Air Quality Emission Modeling Transportation Assumptions.

Vehicle Classification and Cycle [1]
Ore Trucks (Heavy Heavy Duty Diesel (HHDT-DSL) 500 HP with double trailer) CR 595 - 7 trucks; 8 cycles\day; 159,040 miles per truck, 1,192,800 miles total annually CR 510/Red Rd - 9 trucks; 6 cycles\day; 191,520 miles per truck, 1,819,440 miles total annually CR 550/ US-41 - 13 trucks; 4 cycles\day; 181,440 miles per truck, 2,494,800 miles total annually
Logging Trucks and Delivery Trucks All Routes - 12 cycles per day @ 260 days per year = 3,120 cycles per route per year
Passenger and Light Duty Vehicles Vehicles - 175 cycles per day @ 260 days per year = 45,500 cycles per route per year

[1]Source: URS Transportation Study

The emission factor which accounted for all emissions including starting, running, and idling exhaust was selected to evaluate potential emissions from heavy heavy-duty diesel trucks (HHDT-DSL). Inclusion of the PM_{10} and $PM_{2.5}$ emission factors was performed to account for emissions related to tire wear and brake wear. Carbon dioxide and related greenhouse gases have been deemed hazardous pollutants by the EPA and were included this evaluation, however the regulatory reporting of these emissions do not yet extend to operators of a fleet of vehicles. These values, however, can be used in comparisons between routes in the event that greenhouse gas emissions from fleets become regulated.

5.46. A. Analysis of Emissions and Length of Route

A summary of estimated criteria pollutant emissions and greenhouse gases for each of the routes is shown in Table 5-12. Evaluations of routes determined that the length of route is the primary factor determining the amount of emissions produced. This is an expected outcome and a function of the equations used in the model and should weigh heavily when selecting routes to minimize emissions.

Table 5-12. Estimated Tonnage of Emission of Criteria Pollutants and Greenhouse Gas for each Route.

Emissions [1]			
Pollutant	**CR 550**	**Red/SH**	**CR 595**
Criteria Pollutants	Tons	Tons	Tons
PM_{10}	2.45	1.77	0.18
$PM_{2.5}$	2.07	1.50	0.13
NO_x	12.15	8.40	4.92
SO_x	0.08	0.06	0.04
CO	41.06	28.55	16.31
VOC	11.03	7.71	4.37
Total of Criteria Pollutants	**68.83**	**47.99**	**25.95**
Greenhouse Gases			
CO_2	8,789.16	6,306.62	3,843.18
CH_4	0.39	0.28	0.16
Total of Greenhouse Gases	**8,789.5**	**6,306.9**	**3,843.3**
Ratio of the estimated amount of aggregate emissions produced by each route divided by CR 595	2.3	1.6	1.0

[1] Emission Factor References:
Michigan Department of Transportation
TABLE 1; 8 Hour Nonattainment Area Counties Excluding SEMCOG
FY2006 CMAQ Call for Projects--Emissions Factors (from 2005)
SCAQMD / CARB EMFAC2007 (version 2.3) BURDEN MODEL
Emission Factors for On-Road Passenger Vehicles, Delivery Trucks and Heavy-Heavy-Duty Diesel Trucks URL: http://www.aqmd.gov/ceqa/handbook/onroad/onroad.html

CR 550 Route

The CR 550 route is approximately sixty miles in length. The significance of road length of this route as a factor of emission production is shown in Table 5-12. The CR 550 route is nearly three times longer than the CR 595 route and is estimated to generate twice the total amount of criteria pollutants and greenhouse gas. Segments of the route within the City of Marquette proceed through developed areas containing moderate to high density populations. These segments may expose a greater percentage of the public to vehicle-generated emissions. This route is estimated to produce more than twice the amount of emissions than what would be produced by the CR 595 route.

CR 510-Red Road-Sleepy Hollow Route

As compared to other routes, the CR 510-Red Road-Sleepy Hollow route is of intermediate length (42 miles) and therefore generates intermediate levels of emissions. Portions of the CR 510- Red Road-Sleepy Hollow route traverse undeveloped land containing woodland and wetland vegetation. Vehicle emissions may have a negative effect on growth and development of vegetation including negative impacts on gaseous exchange, chlorophyll degradation, starch production and synthesis, damage to leaves and other tissues, growth reduction and ultimately decline in crop yield (Grime, 1970; Bates and Farmer, 1992; Agarwal et al., 2003; and Yi et al., 2005).

CR 595 Route

The CR 595 route will produce the least amount of transportation-related emissions. This route is the shortest route (~~22.5~~ **20.9** miles) and would traverse areas of Champion Township and Ely Township that contain some of the lowest population densities within the study area. Consequently, this route presents the lowest risk of potential impact from emissions on the populace of Marquette County. The majority of this route crosses undeveloped land containing woodland and wetland vegetation. Negative impact to vegetation as a result of vehicular emissions within the road right-of-way may occur as a result of the operation of this route, as explained in the preceding paragraph.

5.46.B. Analysis of Emissions Based on Vehicle Speed

The relationship of speed on estimated emissions of VOCs and NO_X is shown in Figure 5-10. Evaluation of these emission factors demonstrates that at very low speed there is greater potential for emission generation than at moderate speeds. MDOT conducted a study (Draft 9/2010) on the US-41corridor that includes the portions of the roadway between Marquette and Humboldt that reports varying speed limits between 35 and 55 mph. Traffic counts conducted by the MCRC were nonexistent for the majority of the routes evaluated in this document. Since actual data on individual speed limits was limited or nonexistent for sections of the proposed routes average rate of speed for each route was derived from existing data and assigned to portions of segments exhibiting similar characteristics. Using this method, an average speed of 45 miles per hour was used for passenger and light duty vehicles with the exception of the CR 550 route. The CR 550 alternative included 25 mph for the portion that proceeds along Sugarloaf Avenue and Wright Street and 55 mph for the section on CR 550 from Sugar Loaf Avenue to CR 510. A 45 mph speed was applied to the section of and the route containing US-41 through Negaunee and Ishpeming. An average rate of speed of 50 mph was applied to vehicles classified as Heavy Duty Diesel trucks for all routes (URS, 2010).

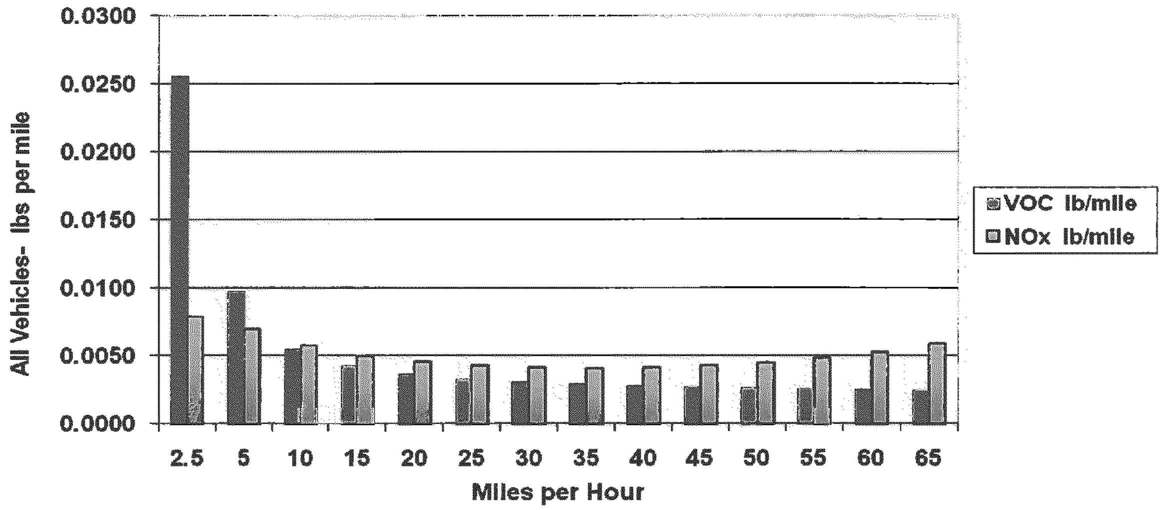

Figure 5-10. The Relationship Between Projected Emission of NO_x and VOCs and Vehicle Speed.

To address pollutant quantities impacted by vehicle speed, three vehicle classifications were used. Model inputs included data from MCRC traffic counters. Routes that traverse through urban areas such as CR 550 through Marquette will have slower speeds and more stopping and starting sequences. Variables such as slope, traffic volume, and composition may result in minor variation between actual and estimated emissions. In addition, changes in driving behavior in adjustment to road conditions and configurations including adverse weather conditions, accelerating to maintain speed when climbing hills, or increased braking when descending steep grades or navigating sharp curves may also result in minor variation between actual and estimated emissions. Routes that traverse long stretches of road and consistently maintain moderate speeds will potentially exhibit lower emissions, as observed in Figure 5-10.

The relationship between speed and emissions should weigh heavily when selecting routes that allow for minimization of the contribution of criteria pollutants emissions to air quality. This is most important where routes may travel through areas of high population densities.

CR 550 Route

Overall, emissions for this route are expected to be low but are likely to exhibit the greatest variability of the routes considered in this analysis. Emissions are expected to be low from the intersection of CR 550 and CR 510 to the intersection of CR 550 and Sugar Loaf Avenue. This segment exhibits a fairly straight alignment and allows for travel at a rate of speed between 45 mph and 55 mph for light duty vehicles that reduces emissions. Loaded Heavy Duty Diesel vehicles are expected to average 50 mph, but will not produce appreciably greater amounts of emissions.

Segments of the route within the City of Marquette and Marquette Township proceed through developed areas containing moderate to high density populations. These segments have potential to expose a greater percentage of the public to increased vehicle-generated emissions as rate of speed decreases below 5 mph often during braking and acceleration associated with stops and traffic congestion. Increases in emissions resulting from decreased speed, idling, stopping and starting are likely to occur at the Sugar Loaf Avenue and Wright Street intersection (traffic signal) and the Wright Street and US-41 intersection (traffic signal). Increases in emissions resulting from decreased speed, idling, stopping and starting may also occur along US-41, as vehicles encounter reduced speed due to long grades, traffic signals, and increased traffic in the vicinity of the cities of Ishpeming and Negaunee.

CR 510-Red Road-Sleepy Hollow Route

The CR 510-Red Road-Sleepy Hollow route contains segments exhibiting grade changes and curves that will require speed reduction and braking during periods of sub-optimal road conditions due to weather-related events. This may result in minor and temporary increases in emission of criteria pollutants. However the majority of the route exhibits lengthy segments of road that allow for maintained speed and reduced emissions. Overall, emissions for this route are expected to be low.

CR 595 Route

Based on the analysis of the routes, the CR 595 route would contribute the lowest amount of vehicle emissions. This is the shortest and most direct route of all the routes and is located in primarily undeveloped areas. Final design and alignment may result in minor changes in slope and speed resulting in corresponding and minor changes in emissions. Minor and temporary increases in emissions resulting from decreased speed, long grades, idling, stopping and starting may occur at the intersection of this route with US-41.

5.47 Summary: Air Quality

In general, emissions related to the proposed increase in vehicular traffic should not impact levels of ozone recorded at the MDEQ Air Quality Monitor at Seney regardless of the route selected. The CR 595 route exhibits the shortest and most direct route of the routes considered and is estimated to produce the smallest amount of vehicular emissions. The CR 595 route traverses land supporting some of the lowest population densities in Marquette County and is least likely to expose populations to increased emissions. Temporary increases in emissions will likely be located at intersections from decreased speed, grade changes, idling, stopping and starting. CR 595 and the CR 510-Red Road-Sleepy Hollow routes are expected to generate fewer emissions from decreased speed, idling, stopping and starting due to fewer encounters with traffic signals. In general, increases in vehicular emissions can result in direct impacts to vegetation and indirect impacts to surface water quality through the increased deposition of criteria pollutants along paved road surfaces.

5.48 Affected Environment: Noise

<u>5.48.A. Acoustical Terminology, Concepts and Sound Perception</u>

Sound is assessed in terms of a unit of measure called Hertz (Hz). Audible sound occurs over a wide frequency range, from approximately 20 Hz to 20,000 Hz. Human hearing responds differently to sounds at different frequencies (or pitch). Sound level perception is expressed in terms of loudness and is measured in units called decibels (dB). Decibels are power ratios and logarithmic quantities. Lower frequency sounds that are equally as "loud"

have a much higher decibel level than high frequency sounds. To accommodate for variation in frequency sensitivity of human hearing, a frequency weighting is often applied to sound level measurements. When the weighting is applied, the resulting sound level measurements are said to be "A-weighted" and the decibel level is expressed as "dBA".
When sound energy doubles, the decibel value increases by 3 dB. Human hearing is logarithmic and therefore when perceived loudness of a sound is "doubled", the corresponding sound level increases by approximately 10 dBA. The average listener begins to detect a change in level at 3 dBA, and a clearly noticeable change occurs at 5 dBA.

A common index, the equivalent sound level, or "Leq", is commonly used to indicate the average sound level over a period of time. Although Leq is an average, it is strongly influenced by the loudest events occurring during the time period because these loudest events contain most of the sound energy.

Table 5-13 lists the association between commonly encountered noise sources, their A-weighted level, and auditory response.

Table 5-13. Commonly Encountered Noise Sources, A-Weighted Level and Auditory Response.

Auditory Response	A- Weighted Level	Common Noise Source
Pain Threshold	140 dBA	Jet Engine (at 60ft)
	130 dBA	"Hard Rock" Band (near stage)
	120 dBA	Thunder (nearby)
Long-term Hearing Loss	100 dBA	Auto Horn (at 9 ft)
	90 dBA	OSHA 8 Hour Noise Exposure Limit
	80 dBA	Street Corner in Busy City
Typical Daily Exposure	70 dBA	Noisy Restaurant
	60 dBA	Typical Office Environment
	50 dBA	
	40 dBA	Average Residence
	30 dBA	
Very Quiet	20 dBA	Whisper
	10 dBA	Human Breathing
Threshold of Hearing	0 dBA	

5.48.B. Traffic Noise Study

A noise study was conducted at noise sensitive areas along the routes shown in Figure 5-9. The data collected for this study include baseline ambient noise level measurements using a sound pressure level and future noise prediction using Federal Highway Administration's (FHWA) Traffic Noise Model (TNM). This study assesses the subjective impact to the residential populations based on projected increases in traffic.

A twenty-four hour sound level measurement was conducted using a sound pressure level along the alternative routes at eight representative locations containing noise-sensitive areas

also known as "noise sensitive receptors" (Table 5-14 and Figure 5-11). Noise sensitive receptors are areas where the existing land use requires low noise levels and typically includes land occupied by churches, public and private schools, libraries, cemeteries, park and recreation facilities, institutions, residential units, and hospitals. Low noise levels are necessary for these types of uses in order to preserve their intended beneficial goals such as education, health promotion, and general state of public well-being.

Of the eight locations selected, seven were considered to be noise sensitive receptors and one (US-41 between Brebner Road and M-35) was selected to assess noise levels associated with a long road grade. The noise measurements at these locations were used to establish baseline ambient noise levels and to verify calibration of the TNM software. In addition, traffic count data completed by MCRC from route segments near noise sensitive receptors were incorporated into the model variables (Table 5-15). Where available, the highest traffic count for twenty-four hour weekday traffic count was incorporated into the TNM model to assess peak traffic noise levels.

Table 5-14. Locations of 24-hour Sound Level Measurements within the Proposed Study Area.

Location Number	Noise Sensitive Receptor Location	Latitude	Longitude
Location 1	Noquemanon Trail Head	46°34'22.25"N	87°24'53.69"W
Location 2	Army Corps of Engineers Office	46°33'50.97"N	87°24'31.25"W
Location 3	Huron Woods Subdivision	46°33'44.34"N	87°27'35.64"W
Location 4	North Star Academy	46°33'18.74"N	87°27'29.86"W
Location 5[1,2]	US-41 between Brebner Road and M-35	46°32'10.00"N	87°31'11.37"W
Location 6	CR 573, West Ishpeming	46°30'56.83"N	87°40'31.96"W
Location 7	Wolf Lake Road North of US-41	46°30'2.39"N	87°53'12.59"W
Location 8[1]	Dead River Camps on Red Road	46°36'45.58"N	87°43'56.17"W

[1]Traffic counts from MCRC were not available for the route segment at the route survey location and were therefore estimated.
[2]Not a noise sensitive receptor but assessed for noise associated with long road grades.

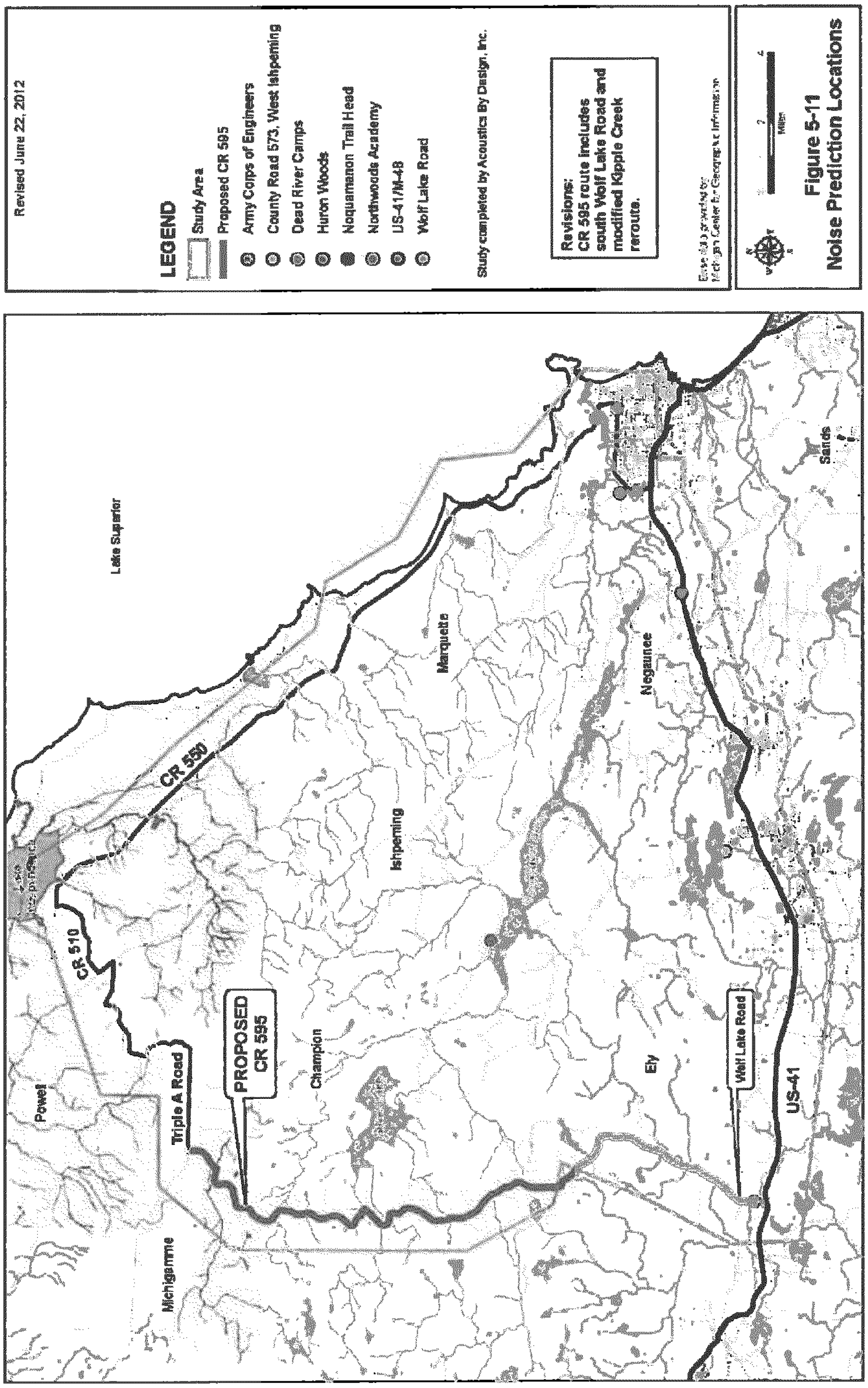
Revised June 22, 2012
LEGEND
Study Area
Proposed CR 595
Army Corps of Engineers
County Road 573, West Ishpeming
Dead River Camps
Huron Woods
Noquamanon Trail Head
Northwoods Academy
US-41/M-48
Wolf Lake Road
Study completed by Acoustics By Design, Inc.
Revisions:
CR 595 route includes
south Wolf Lake Road and
modified Kipple Creek
reroute.
Figure 5-11
Noise Prediction Locations
Lake Superior
CR 550
CR 510
Triple A Road
PROPOSED
CR 595
Powell
Champion
Michigamme
Ishpeming
Marquette
Negaunee
Ely
Sands
Wolf Lake Road
US-41

Table 5-15. Marquette County Road Commission Traffic Count Survey Locations and Dates.

Measurement Location	Counter	Road Name	Location Description	Study Dates
Location 1	33-a	CR 550	Marquette City Limit	6/25/07 to 7/2/07
Location 2	8-8-b	CR 492	S. of County Road HD	5/11/10 to 5/18/10
Location 3	8-8-a	CR HD-Forestville Rd	N 492	5/11/10 to 5/18/10
Location 4	178	CR 492 – New	N of US-41	5/11/10 to 5/18/10
Location 5[1,2]	Traffic Count Estimated			
Location 6	11-1-a	CR 573	At Carp River	7/14/09 to 7/21/09
Location 7	903	Wolf Lake Road North of US-41	At RR Tracks	7/20/10 to 7/27/10
Location 8	Traffic Count Estimated			

[1]Traffic counts from MCRC were not available at for the route segment at the route survey location and were therefore estimated.
[2]Not a noise sensitive receptor but assessed for noise associated with long road grades.

Noise Study Criteria

FHWA document 23 CFR 772 "Procedures for Abatement of Highway Traffic Noise and Construction Noise" provides guidance for determining both the community response to increases in ambient noise levels and mitigation recommendations. The primary indicator in this analysis is the "Noise Abatement Criteria" or NAC as defined by FHWA - 23 CFR 772 (Table 5-16) that defines traffic noise impacts as those that occur when:

1.) the predicted traffic noise levels approach or exceed the noise abatement criteria, or

2.) the predicted traffic noise levels substantially exceed the existing noise levels.

This definition reflects the FHWA position that traffic noise impacts can occur under either of two separate conditions: 1) when noise levels are unacceptably high (absolute level); or, 2) when a proposed project will "substantially exceed" the existing noise environment. In order to adequately assess the noise impact of a proposed project, both criteria must be analyzed. In addition, FHWA - 23 CFR 772 purposefully provides State Highway Authorities with the flexibility to establish their own definition of "substantially exceed".

While the FHWA noise regulations do not define "approach or exceed", all State Highway Authorities must establish a definition of "approach" that is at least 1 dBA less than the NAC for use in identifying traffic noise impacts shown in Table 5-9. The Michigan State Transportation Commission Policy on Noise Abatement Guidance Document 10136 accepts the FHWA document 23 CFR 772 criteria. Factors such as available resources, the public's attitudes toward highway traffic noise, and the absolute noise levels may influence a state's definition of substantial increase. The FHWA will accept a well-reasoned definition that is uniformly and consistently applied.

The State of Michigan Guidance Document 10136 defines a Noise Impact as noise levels that are one dBA below or greater than the federal noise abatement criteria, as shown in Table 5-9, or are expected to increase 10 dBA above baseline ambient noise levels as measured with a sound level meter. In accordance with the provided guidelines, the NAC for the State of Michigan and for the purpose of this study will be levels that exceed the FHWA-23 CFR 772 NAC criteria minus 1 dBA, or if predicted levels exceed the baseline ambient noise levels by more than 10 dBA. Noise ordinances within Marquette County are established through the cities and townships. Local ordinances do not have specific NAC and do not explicitly address impacts related to noise generated from vehicular traffic. In general, local noise ordinances would pertain to noise levels generated by construction of the routes. In most cases construction-related noise would be subject to restrictions limiting the time of day when construction activity would be allowed to occur.

The purpose of the study is not to determine locations to propose noise abatement, but rather to evaluate the potential noise impact of the increased vehicle traffic along the routes evaluated. The NAC are useful for framing the context of the noise impact of each route.

Table 5-16. FHWA document 23 CFR 772 Noise Abatement Criteria for $L_{Eq}(h)$.

Activity Category	$L_{eq}(h)$	Description of Activity Category
A	57 Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 Exterior	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	72 Exterior	Developed lands, properties, or activities not included in Categories A or B above.
D	N.A.[1]	Undeveloped lands.
E	52 Interior	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

N.A[1]. - Noise abatement criteria not developed for undeveloped lands

5.48.C. Baseline Noise Conditions

Recordings of the level of baseline ambient noise at noise sensitive receptors were assessed during the week of November 15, 2010 and are shown in Table 5-17.

Table 5-17. Baseline Ambient Noise Survey Results at Noise Sensitive Areas (All Results in Dba).

Location	Noise Sensitive Receptor Location	Activity Category (FHWA-23CFR 772)	NAC-L_{eq}(h) (FHWA-23CFR 772)	Recorded L_{eq}(24h)
Location 1	Noquemanon Trail Head	B	67	63
Location 2	Army Corps of Engineers Office	B	67	64
Location 3	Huron Woods Subdivision	B	67	55
Location 4	North Star Academy	B	67	58
Location 5[1,2]	US-41 between Brebner Road and M-35	C	72	69
Location 6	CR 573, West Ishpeming	B	67	57
Location 7	Wolf Lake Road North of US41	B	67	50
Location 8	Dead River Camps on Red Road	A	57	38

[1]Traffic counts from MCRC were not available at for the route segment at the route survey location and were therefore estimated.
[2]Not a noise sensitive receptor but assessed for noise associated with long road grades.

<u>*5.48.D CR 550 Route*</u>

Baseline levels of ambient noise recorded at the noise sensitive receptors at Locations 1, 2, 4 and 5 do not exceed the NAC.

<u>*5.48.E. CR 510-Red Road-Sleepy Hollow Route*</u>

Baseline levels of ambient noise at Location 8 do not exceed the NAC. The sound level measurement of 38 dBA was the lowest level of ambient noise recorded during the survey.

<u>*5.48.F. Wolf Lake Road East of Proposed CR 595 Route*</u>

Baseline levels of ambient noise recorded at the noise sensitive receptor at Location 7 do not exceed the NAC.

5.49 Environmental Consequences: Noise

<u>*5.49.A. Predicted Traffic Noise Impacts*</u>

The noise study included baseline ambient noise level measurements, future noise predictions using FHWA's TNM, and predicted the subjective impact to the community resulting from the increase in traffic should a permit be granted for CR 595 and should the project be implemented. The analysis was performed at eight locations containing noise sensitive receptors. MCRC traffic counts were used for the models (Table 5-15). In addition, the predicted noise levels were compared to the 24-hour sound level measurements to validate TNM model accuracy. Under all conditions both the predicted existing noise levels and the measured existing noise levels varied by no more than +/- 2 dBA. The TNM models were analyzed with the projected traffic increase of five heavy trucks per hour. The results of the predicted noise levels were compared against the FHWA and State of Michigan NAC previously discussed. Model predictions, validation, and evaluation of the predicted increased noise levels compared to NAC for this study and FHWA - 23 CFR 772 are shown in Table 5-18.

Table 5-18. TNM Model Predictions and Subjective Change in Noise Levels Compared To NAC for This Study and FHWA - 23 CFR 772 (All Measurements in Dba).

Location	Activity Category (FHWA-23CFR 772)	Sensitive Noise Receptor Location	NAC-L_{eq}(h) (FHWA-23CFR 772)	Measured L_{eq}(24h)	Predicted Existing L_{eq}(h)[1]	Predicted Future L_{eq}(h)[1]	Predicted Increase in Noise Level (dBA)	Subjective Change in Noise Level
Location 1	B	Noquemanon Trail Head	67	63	62	63	1	Little Increase
Location 2	B	Army Corps of Engineers Office	67	64	64	65	1	Little increase
Location 3	B	Huron Woods Subdivision	67	55	55	58	3	Little Increase
Location 4	B	North Star Academy	67	58	60	61	1	Little Increase
Location 5	C	US-41 between Brebner Road and M-35	72	69	67	67	0	Little Increase
Location 6	B	CR 573, West Ishpeming	67	57	56	59	3	Little Increase
Location 7	B	Wolf Lake Road North of US-41	67	50	51	56	5	Little Increase
Location 8	A	Dead River Camps on Red Road	57	38	37	56	19	Substantial Increase

[1]Predicted Existing Leq(h) - TNM Model prediction of existing or future ambient noise levels at survey locations.

CR 550 Route

Predicted levels of ambient noise recorded at noise sensitive receptors at Locations 1, 2 and 4 and 5 do not exceed NAC. Therefore, the projected increase in traffic noise will not result in a significant noise impact.

CR 510-Red Road-Sleepy Hollow Route

Predicted levels of ambient noise recorded at noise sensitive receptors at along the Red Road segment of this alternatives do not exceed FHWA - 23 CFR 772 NAC. However, the TNM model predicts a 19 dBA increase in noise level over baseline conditions. The State of Michigan Guidance Document 10136 defines a noise impact as noise levels that are one dBA below or greater than the federal noise abatement criteria, or those levels that are expected to increase 10 dBA above baseline ambient noise levels as measured with a sound level meter. Consequently, the projected increase in traffic noise will result in a significant noise impact at Location 8 on Red Road (Dead River camps).

Wolf Lake Road east of Proposed CR 595 Route

Predicted levels of ambient noise recorded at the noise sensitive receptor at Location 7 do not exceed NAC. Therefore, the projected increase in traffic volume if this route were used for the anticipated traffic will not result in a significant noise impact at Location 7. It should be noted that the proposed route for CR 595 is approximately 0.5 mile west of Location 7, which should result in further minimization of traffic-related noise to the residential area on Wolf Lake Road near Location 7.

5.49.B. Impacts of Traffic Related Noise on Wildlife

Studies of noise impacts on wildlife are extensive and indicate both negative and positive impacts on wildlife populations (Parris and Schneider 2008). Change in territorial range, nesting behavior, migratory movement, pitch and frequency of vocalizations, and reductions in fitness and reproductive capacity due to stress are listed impacts in birds, mammals, reptiles and amphibians from noise associated stress (Benson, R. 1995, Eigenbrod et al., 2009, Grubb et al., 1998, Hoskin and Goosem, 2010). It is important to note that not all species have shown these effects. In some instances, species may benefit from the establishment of transitional ecological zones that typically occur along roadways that would increase populations of those species near roads (Kaseloo P.A., 2006).

5.50 Summary: Noise

Based on the field measurements and traffic noise models, there is no predicted impact to the noise levels at sensitive receptor Locations 1-7 if these routes are implemented. However, a substantial increase in noise levels is predicted at Location 8 (Dead River camps) along the Red Road segment of the CR 510-Red Road-Sleepy Hollow route. This increase is primarily due to the existing baseline condition that exhibits a low level of ambient noise and is related to the low level of development and traffic observed in the surrounding area.

Several noise sensitive receptors are located along segments of routes that traverse moderate-to-high density populations where baseline ambient noise levels are a few dBAs less than the FHWA-23CFR 772 NAC threshold levels. However, changes in existing ambient noise levels would need to increase significantly to result in an increase in excess of 10dBA that would represent a noise impact. Impacts of noise on wildlife from vehicular traffic are likely to be mixed as some species may avoid the roadway, while others may not be impacted and/or seek out the roadway corridor as a preferred habitat.

5.51 Affected Environment: Geological Resources

The road routes investigated traverse various geologic resources including bedrock formations, surficial geology (mostly unconsolidated glacial and alluvial deposits) and soils. Soils are derived from glacial and alluvial deposits and contain living organisms, such as plant roots, fungi, micro-organisms and animals. Unconsolidated glacial and alluvial deposits below the biologically active surface soils lack the biological activity of soils.

Soils function as reservoirs of water and plant nutrients, provide habitat for animals, and host vital biogeochemical processes required for cycling energy and nutrients through wetland and terrestrial ecosystems. Soils contribute beneficial nutrients to aquatic ecosystems, including lakes and streams, but can also become a source of pollution as a result of erosion and sedimentation processes.

5.51.A Bedrock Geology

The bedrock geology of Michigan's Upper Peninsula is split into two distinct terrains: 1) the Precambrian and Lower Paleozoic igneous, metamorphic, and sedimentary rocks found on the western half; and, 2) the much younger Paleozoic formations found on the eastern half. The Precambrian metamorphosed igneous and sedimentary rocks of an ancient mountain range are upwards of 3.5 billion years old, while the eastern Paleozoic rocks, mainly sandstones and limestones, are approximately 310 million to 600 million years old (Dorr and Eschman, 1970).

Figure 5-12 below, which includes the alternative routes west of Marquette, illustrates the consolidated bedrock formations found below the unconsolidated glacial drift. On Figure 5-12, the Paleozoic Jacobsville Sandstone and the Siamo Slate-Ajibak Quartzite are relatively younger rocks, believed to be approximately 500 million to 600 million years old, while the major formations south of the Jacobsville, the Archaean and Michigamme formations are much older Precambrian-aged rocks. Archean bedrock often exhibits low permeability, which restricts water infiltration and creates the many lakes, wetlands and streams in Marquette County. The Jacobsville formation is comprised of red, brown, and white quartz-rich sandstone and is an important aquifer along the Lake Superior shoreline. This formation has been quarried for building stone and contains minor components of shale and conglomerate.

From a transportation management perspective, the bedrock geology, when near the ground surface, largely determines surface topography, elevations and grades, and may require significant modification in order to construct roads.

5.51.B. Surficial Geology

Surficial geologic resources within the study area consist of approximately 12,000-year-old unconsolidated Pleistocene Late-Wisconsinan glacial drift, younger alluvial sediments, organic peats and mucks. Glacial drift varies in thickness, texture, and degree of sorting throughout Marquette County. These sediments are closely tied to hydrologic conditions, soil composition, and land use. Basic categories of surficial deposits include the following:

Thin to discontinuous glacial till and coarse-textured till.
These deposits are relatively unsorted and range in thickness from a few inches to about 60 feet. The central area of Marquette County has broad areas of this thin deposit covering bedrock highlands. Bedrock is often exposed where the glacial till has washed away.

Outwash sand and gravel and recent alluvium.
These deposits consist of stratified, well-sorted sands and gravel. They range in thickness from several feet to as much as 300 feet and are often valuable, high-yield aquifers.